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(71) Applicant: MATSUSHITA ELECTRIC INDUSTRIAL CO., LTD.
Kadoma-shi, Osaka 571-8501 (JP)

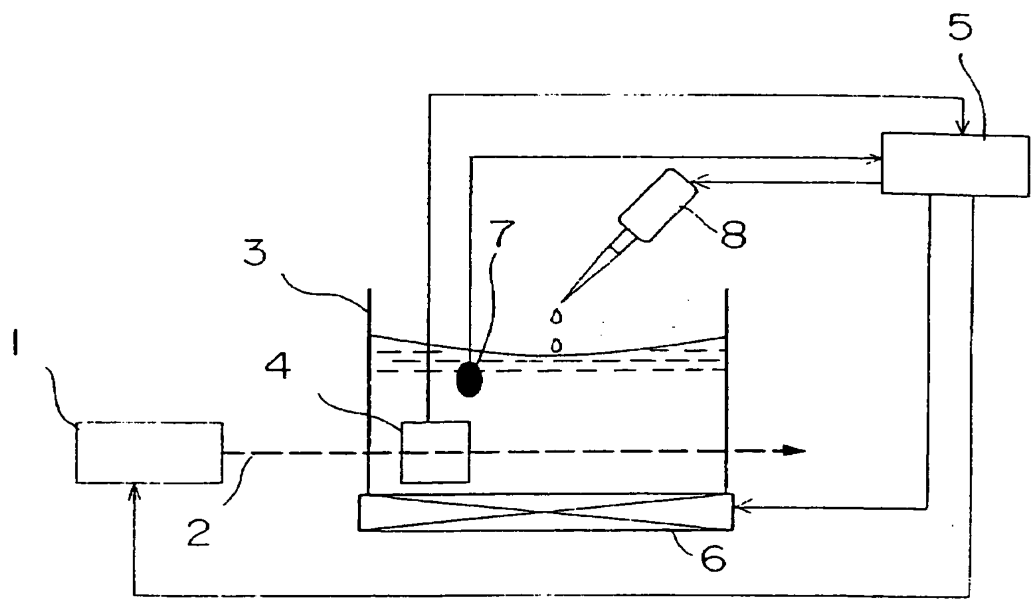
(72) Inventor: Kawamura, Tatsurou
Kyotanabe-shi, Kyoto 610-0351 (JP)

(74) Representative:
Leson, Thomas Johannes Alois, Dipl.-Ing. et al
Patentanwälte
Tiedtke-Bühling-Kinne & Partner,
Bavariaring 4
80336 München (DE)

(54) Method for measuring concentration of solution and method of urinalysis using the same

(57) The present invention provides a method for measuring concentration of a solution, in which an acid is mixed in a sample to be detected to reduce the variations in pH, and the mixture is heated up to not more than 80 °C to measure the transmitted light and/or scattered light power. The present invention also provides a method of urinalysis in which the protein concentration is measured after measuring the angle of rotation. Herewith, in the method in which the sample to be detected is heated to coagulate protein, and the protein concentration is measured from the degree of opacification resulting therefrom, it is possible to reduce the influence of the pH of the sample to be detected, and to decrease the heating temperature.

FIG. 1



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Description

BACKGROUND OF THE INVENTION

[0001] The present invention relates to a method for measuring the concentration of a specific component contained in a sample to be detected, and a measuring apparatus thereof. More particularly, the present invention relates to a method for measuring the concentration of protein, and the concentration of glucose in a urine collected from a human, or other animals.

[0002] The glucose concentration in a urine (i.e., urine sugar value) and the protein concentration in a urine (i.e., urine protein value) reflect a part of the health condition. Then, there has been a demand for an easy and accurate measuring method thereof.

[0003] A conventional urinalysis has been accomplished in the following manner. That is, a test paper impregnated with a reagent corresponding to each inspection item such as sugar or protein is dipped in a urine. Then, the color reaction of the test paper is observed by means of a spectrophotometer or the like. With this method, a different test paper is required for each inspection item, and a new test paper is required for every inspection. Therefore, there has occurred a problem of a high running cost. Further, there has also been a limit as to the automation of a urinalysis for laborsaving.

[0004] Especially when such test papers are used at home, an amateur is required to perform setting and exchanging of the test papers. This operation is relatively complicated, and disliked, thus inhibiting an urinalysis apparatus from coming into widespread use at home.

[0005] In contrast, in PCT International Publication No. 97/18470, there is proposed a method of urinalysis requiring no consumable items such as test papers. This method is based on the notice that glucose and albumin exhibit optical activities, while the other urine components exhibit almost no optical activities. Namely, with this method of urinalysis, the urine sugar value and the urine protein value are determined by measuring the angle of rotation of the urine.

[0006] When a light is propagated in a liquid containing an optical active substance, the polarization direction of the light rotates in proportion to the concentration of the optical active substance. That is, the formula (1) :

$$A = L \times \alpha \tag{1}$$

where L denotes a measured optical path length, A denotes an angle of rotation (degree), and α denotes a specific rotatory power is satisfied.

[0007] For example, when a light with a wavelength of 589 nm is propagated 100 mm in an aqueous glucose solution with a concentration of 100 mg/dl, the polarization direction of the light rotates 50×10^{-3} degrees. By utilizing such characteristics, it is possible to determine the urine sugar value and the urine protein value from the formula (1). Herein, the respective specific rotatory powers of glucose and albumin at 20 °C are shown in Table 1.

Table 1

		Wavelength (nm)	
		589	670
Specific rotatory power (degree)	Glucose	50	40
	Albumin	-60	-40

[0008] When N types of optical active substances are contained in the liquid, the formula (1) is reexpressed as the following formula (2):

$$A = L \times (\alpha 1 \times C1 + \alpha 2 \times C2 + \cdots + \alpha N \times CN) \tag{2}$$

where L denotes a measured optical path length, A denotes an angle of rotation (degree), and αN denotes the specific rotatory power of a substance "n", N is a natural number of from 1 to n, and CN denotes the concentration (kg/l) of the substance "n".

[0009] As apparent from the formula (2), the information on a plurality of optical active substance concentrations are included in the angle of rotation of the liquid obtained by measurement. Namely, the sum of the angle of rotation attributed to glucose and the angle of rotation attributed to albumin is included in the angle of rotation obtained for a urine.